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BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

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WESTERN PINE BEETLE SURVEY

HAPPY CAMP-LAVA BED AREA

MODOC NATIONAL FOREST

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by

F. P. KEEN
Associate Entomologist

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Stanford University, California
November, 1928

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MODOC NATIONAL FOREST
NOVEMBER, 1928

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WESTERN PINE BEETLE SURVEY
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Preface

The seventh annual survey of the Happy Camp-Lava Bed Area was carried out by the Bureau of Entomology from September 3 to October 15 of this year. The purpose of this survey was to determine the course of the western pine beetle epidemic, which started in 1924, and evidence as to underlying causes of such epidemics and methods of predicting their trend.

As in past years, the Bureau of Entomology paid the salaries of its personnel engaged in the work, and the Forest Service and private owners paid the field expenses of the work. The writer was assisted in the survey by Messrs. I.J. Hastings, Ernest Buck and W. S. Greene.

The total cost of the survey was as follows:

Salaries (Bureau of Entomology) -	$910.00
Expenses (Forest Service)- - - - -	239.61
Total - - - - - -	$1149.61

The western pine beetle infestation on the Happy-Camp-Lava Bed Area has been under the observation of the Bureau of Entomology since 1922, and each year a report has been made to the interested owners as to the status of the infestation. The present report covers the conditions found on the area in the fall of 1928. At the time of the survey only from 60% to 90% of the total seasonal loss could be counted, since the attacks of the overwintering generation of beetles were still in progress.

Resumé of Past Infestation

Before the surveys were started on the area a number of reports were received of the heavy losses of western yellow pine as a result of insect activity. Undoubtedly the epidemic of 1917-1918-1919, which was general thoughout the southern Oregon area, had also affected the Happy Camp area in a similar way. When the first survey of the area was made in 1922 this old loss was very much in evidence, but the decline in activity had already set in and the epidemic was returning to a normal status. This was reached in 1923. Then came the series of dry years of 1923, 1924, 1925 and 1926 and a new epidemic developed, reaching far greater proportions than the earlier one of 1917-1919. In 1927 the epidemic became so virulent that in some portions of the area as much as 14% of the stand was killed during the year.

Since 1921 the course of the epidemic over the area as a whole (exclusive of Widow Valley, Hot Springs and Buck Valley Units) has been as follows:

Year	Per cent of Stand Killed	Volume M.B.M.
1921	.72	40,033
1922	.58	32,438
1923	.30	16,610
1924	.59	33,140
1925	1.12	62,680
1926	2.04	115,200
1927	3.26	183,900
1928*	2.38	134,000

*Predicted loss for 1928

The Present Infestation

The long-hoped-for decline in the epidemic at last has come. Throughout the area the 1928 loss is considerably less than that of 1927. In some portions of the area indications of the decline were evident last year and affected the amount of the 1927 kill. This was particularly noticeable in the northern and eastern parts of the Glass Mountain Unit. This decline continued in 1928. As was predicted in last year's report, the infestation on the Badger Unit continued to be severe, although less than that of 1927. On the average, the 1928 infestation on the check sections amounted to about 60% of the 1927 loss, while the general estimates indicated the 1928 loss to be about 73% of the 1927 loss in volume. The summer generation kill was very heavy and occurred in large groups. The big reduction, however, was in the winter generation. While the summer generation represented about 47% of the total 1927 kill, the winter loss amounted to about 13% of the total 1927 kill, or only about a quarter as much as the corresponding winter loss of 1927. Evidently the big decrease in beetle activity occurred during the summer of this year. The causes are no doubt complex, but probably one of the most important factors was the increased growth and resistance of the trees. (The 1928 ring growth was the largest since 1923.)

Now that a very decided decline has started, the evidence from previous epidemics would indicate that it will continue until beetle activity has again reached normal proportions, after which a new epidemic may develop if favorable conditions again prevail.

A summary of the infestation's progress on the different units of the area may be of interest.

Glass Mountain Unit

During 1928 the decline in the epidemic was very marked in the old areas of beetle destruction along the northern and eastern borders of the unit. This infestation, however, moved back into the heavier stands of the higher levels when a severe loss developed, but with a decrease in virulence over that of previous years.

The trend of the epidemic on this unit has been as follows:

Glass Mountain Unit

Year	Per cent Stand Killed on Check Section	Average Per cent Stand Killed on Unit	Volume Timber Killed on Unit (M.B.M.)
1921	.89%	.75%	9,480
1922	1.89	.68	8,330
1923	.51	.31	3,830
1924	1.75	.81	9,800
1925	3.82	1.21	14,680
1926	5.57	1.71	20,750
1927	4.47	1.81	22,000
1928	4.18(Est.)	1.61	19,800

Timber Mountain Unit

A very remarkable drop in the infestation of this unit occurred in 1928. From a loss of 12.28% of the stand in 1927, the loss declined to 2.05% in 1928. This was probably due to the fact that such a high percentage of the stand had been killed by the fire of 1924 and the subsequent beetle activity, both within and outside of the burned area, that most of the beetle-susceptible trees in the stand had been eliminated and the stand opened up for the growth of the thriftier, more resistant trees.

Since 1921 this unit has suffered the following losses from beetle activity:

Timber Mountain Unit

Year	Average Per cent Stand Killed	Volume Timber Killed on Unit M.B.M.
1921		1,300
1922		1,291
1923		1,000
1924		1,500
1925	5.52	1,170
1926	8.64	1,900
1927	14.30	3,150
1928	2.05(est.)	450

Badger Unit

The aggressive epidemic which recently started on the Badger Unit was the cause of much alarm on the part of the Forest Service and the Pickering Lumber Company. That this epidemic might continue in aggressive form or increase in severity was a contingency that had to be faced, since the stand was badly overmature, with a high percentage of susceptible trees. Furthermore, the beetles had not been active in this unit for many years, so that it appeared altogether probable that they might wipe out from twenty-five to fifty per cent of the stand before being checked by natural causes, as they had done on the portions of the Glass Mountain Unit.

The seriousness of this situation brought about the sale of the government stumpage on the Badger Unit, with the provision that the successful bidder should control the infestation through logging operations or through the regular control method of felling and burning the infested material. The Pickering Company was the successful bidder, and started control operations on a 15,000-acre tract within the sale area on October 15 of this year.

As predicted in the 1927 report, the epidemic in 1928 continued to be severe. The summer generation killed a volume of timber equal to 47% of the total killed in 1927; but the winter generation showed a very marked decline and represented only 26% of the previous year's winter loss. Even so, the winter loss was high and ran about 125 trees per section on the control area.

The following table shows the progress of this infestation on the Badger Unit since records were started:

Badger Unit

Year	Per cent Stand Killed on Check Sections	Average Per cent Stand Killed on Unit	Volume of Loss on Unit (M.B.M.)
1921	1.18%	1.56%	11,140
1922	.90	.78	6,421
1923	.40	.38	3,080
1924	.70	.58	4,710
1925	1.31	1.50	12,240
1926	2.94	3.47	28,350
1927	6.55	10.95	89,600
1928(est.)	3.70	7.38	60,400

Lava Unit

With great consistency the scattered pine stands on the lava beds have resisted the onslaughts of the beetles. In 1927 the infestation increased slightly, but promptly dropped again in 1928. This resistance to insect attack is undoubtedly due to the lack of competition between the trees and their relatively rapid growth.

Since 1921 the Lava Unit has shown losses as follows:

Lava Unit

Year	Per cent Stand Killed on Check Sections	Average Per cent Stand Killed on Unit	Volume of Loss on Unit (M.B.M.)
1921	----	.88	7,150
1922	----	.76	4,800
1923	----	.52	3,280
1924	----	.70	4,420
1925	1.23	1.46	9,250
1926	1.47	2.00	12,600
1927	2.13	2.22	14,000
1928	.96	1.37	8,650

Happy Camp Unit

A great improvement in the appearance of this unit was noted this year. The large groups that were dying in 1926 and 1927 have now lost their bright red color and are fast becoming inconspicuous. The newly-killed trees are much less in evidence and tend to be scattered through the stand rather than to occur in concentrated groups. It appears to be quite certain that the recent epidemic has spent itself in this unit, for the present at least.

The trend of the epidemic in this unit has been as follows:

Happy Camp Unit

Year	Per cent Stand Killed on Check Sections	Average Per cent Stand Killed on Unit	Volume of Loss on Unit (M.B.M.)
1921	.47	.72%	9,420
1922	.57	.54	7,067
1923	.19	.24	3,180
1924	.57	.77	9,220
1925	1.90	.87	11,280
1926	4.78	2.19	28,400
1927	3.15	2.16	28,000
1928	1.45	1.54	20,100

Pit River Unit

In conformity with the rest of the area, the Pit River Unit showed a decline in infestation during the year. This unit comprises a mixed ownership of government and Pickering lands and was made a part of the Badger sale area. With the exception of a ridge in T 42 N, R 9 E, which has suffered a heavy loss, the unit has never undergone a particularly severe kill since it has been under observation. The open and mixed character of the stand has probably kept it from being a very susceptible type.

The losses as shown by the check section and general estimates are as follows:

Pit River Unit

Year	Per cent Stand Killed on Check Sections	Average Per cent Stand Killed on Unit	Volume of Loss on Unit (M.B.M.)
1921	.95	.98	3,040
1922	1.88	1.16	3,604
1923	.79	.52	1,620
1924	.77	.64	1,970
1925	1.66	1.00	3,120
1926	1.54	2.38	7,350
1927	1.47	3.28	10,150
1928	1.07	2.26	7,000

White Horse Unit

The White Horse Unit, which lies in the southern part of the Happy Camp area, comprises a very fine stand of pine with some admixture of fir and other conifers. The private lands within the unit have been sold recently by the Red River Lumber Company to the McCloud Lumber Co.

During 1928 a very heavy loss was suffered in the stands which border the lava beds. Large groups of trees were killed over several square miles of forest. The check section showed a decline for the year in number of trees killed, but an increase in volume. It is expected, however, that the unit will respond to the natural control factors that are affecting the infestation on the rest of the area, and that no further increases in this unit will be experienced.

It is understood that the McCloud Lumber Company are now carrying on a maintenance control operation in this tract, as they have done for a number of years on some of their other holdings.

The progress of the infestation on this unit has been as follows:

White Horse Unit

Year	Per cent of Stand Killed on Check Section	Average Per cent Stand Killed on Unit	Volume of Loss on Unit (M.B.M.)
1921	.39	.20	2,650
1922	.78	.24	3,162
1923	.58	.17	2,300
1924	.78	.44	5,910
1925	1.25	.82	10,940
1926	1.84	1.19	15,850
1927	1.88	1.27	17,000
1928	2.10	1.54	17,300

Badger Sale Area

In order to check the wholesale destruction of mature pine timber on the Badger Unit and to salvage a part of that recently killed, the Forest Service made an appraisal of the unit in the spring of the year and sold the timber on bid to the Pickering Lumber Company. The contract of sale provided for the removal of all infested timber on an area of 15,000 acres before June 1, 1929, or, in case removal was impracticable, the burning of all bark infested with the western pine beetle, the mountain pine beetle or the engraver beetle. In the second and third years 30,000 acres must be cleaned of infestation each year, provided the previous year's loss is more than three per cent of the stand. Since the loss on the Badger Unit for 1928 is in excess of seven per cent of the stand, control will have to be conducted on the 30,000-acre tract during 1929-30.

Since it was improbable that a railroad could be constructed to the area in time to remove the infested material before June 1, 1929, the company elected to treat the infested trees on the 15,000 acres by the usual control methods. These methods consist of felling the trees, peeling the upper half of the log, piling the brush over the top and burning bark and slash. The log itself is not seriously damaged unless it has a punky heart or is very dry and pitchy.

A camp of twelve cabins, mess hall and cook house was constructed at Brown's Well, and the work of treating the infested material was started on October 16. About 40 men were employed.

Under a cooperative agreement, the Bureau of Entomology took charge of the marking work, and the expenses were equally divided between the Forest Service and the Pickering Lumber Company, since the work was to be conducted over an equal area of government and private land. A crew of three experienced spotters was assigned to this work. By the middle of November half of the area had been marked, and it was expected that the work could be completed by the latter part of December.

At the beginning of the work the writer estimated that 3,100 trees with 2,500 M.B.M. would be found infested with overwintering broods on the 17,720 acres included within the boundaries established for the 1928-29 control work, and would require treatment in that work. On December 1, 76% of the area had been spotted, and the actual loss was 39% less than the estimate. On the government township the loss was somewhat higher than the estimate and on T 43 N, R 8 E somewhat less.

At the Company's request, one of the Bureau of Entomology's temporary men, Ernest Buck, who had had considerable experience in handling control camps, was turned over to the Company to take charge of the treating crews. Under his supervision a very excellent quality of control work was being done. The infested bark was thoroughly burned and the brush disposed of with a minimum of damage to reproduction and mature trees. Since the burning work was not started until late in October, no trouble was experienced in handling the fires, and after the first snow fire lines were dispensed with.

After the control work was started the Company bought a small mill, placed it in the northeast corner of Sec. 7, T 43 N, R 8 E, and planned to cut the infested trees in the adjoining four sections into ties for their spur construction. Just how much the mill can handle and how far they can afford to go for scattered infested trees will not be known until next year.

Recommendations

As a result of the Badger Springs Sale and the control work which must be carried on by the Pickering Lumber Company under the clauses of the sale contract, the control of the beetles on the only area recommended for control last year is now provided for.

The other units of the Happy Camp area are on the decline and will probably continue so for some time; at least, no action toward control would appear to be necessary on any of them at this time.

The only action that needs to be considered is the continuance of the check surveys. These surveys serve three purposes: (1) keeping the area under close observation, so that any flare-up of insect activity can be quickly noted; (2) providing information to the owners of the amount of current losses and location of control work; and (3) securing investigative data of considerable importance. Altogether it seems decidedly worth while to continue these surveys for the next few years at least.

HAPPY CAMP-LAVA BED AREA

Predicted Loss
for 1928

Unit	Acres	Volume of Stand(M.B.M.)	Killed During 1928			
			Trees	Av. Vol. per Tree	Volume (M.B.M.)	Per cent of Stand
Glass Mt.	68,860	1,214,300	27,800	700	19,500	1.61%
Timber Mt.	2,600	22,000	600	750	450	2.05%
Badger	67,760	818,460	75,500	800	60,400	7.38%
Lava	73,200	631,300	11,500	750	8,650	1.37%
Happy Camp	68,660	1,298,840	22,500	890	20,100	1.54%
Pit River	35,200	310,140	8,200	850	7,000	2.26%
White Horse	60,800	1,337,720	14,900	1200	17,900	1.54%
Total	377,080	5,632,760	161,000	832	134,000	2.38%

HAPPY CAMP-LAVA BED AREA

Volume (M B.M.) of 1928 Loss by Ownership

Unit	Nat. Forest	Long-Bell Lbr.Co.	McCloud Lbr.Co.	Red River Lbr.Co.	Pickering Lbr. Co.	Other	Total
Glass Mt.	5,950	4,250	---	---	9,300	---	19,500
Timber Mt.	350	80	---	---	---	20	450
Badger	28,300	---	---	3,750	27,800	550	60,400
Lava	8,200	---	450	---	---	---	8,650
Happy Camp	1,500	---	---	16,300*	2,100	200	20,100
Pit River	3,250	---	---	400	3,320	30	7,000
White Horse	2,420	---	14,950	---	---	630	17,900
Total	49,970	4,330	15,300	20,450	42,520	1,430	134,000

* Egg Lake Tract under option to the Pickering Company

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
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CALIFORNIA
MT. DIABLO MERIDIAN
1920

Scale
1 ½ 0 1 2 3 4 5 Miles

HAPPY CAMP-LAVA BED AREA
MODOC NATIONAL FOREST, CALIFORNIA

PREDICTED PINE BEETLE KILL FOR 1928

Legend

Unit Boundaries

Boundary of Badger Sale Area

Boundary of 15,000-acre Control Area for 1928-29

Per cent of Stand Killed in 1928:

Less than 1.5%
(offset by growth)

From 1.5% to 3.0%

From 3.0% to 4.5%

From 4.5% to 6.0%

Over 6.0%

P.P.K.Dec.'28

R. 14 E.
8th.
R. 15 E.
T. 40 S.
T. 41 S.
T. 48 N.
T. 47 N.
T. 46 N.
T. 45 N.
T. 44 N.
T. 43 N.
T. 42 N.
T. 41 N.
T. 40 N.
T. 39 N.
42°
50'
40'
30'
20'
9th.
Glass Mt. Unit
Timber Mt. Unit
Badger Unit
Pit River Unit
Happy Camp Unit
White Horse Unit
Glass Mt
Timber Mt
Hoffman
Ice Cave
Straw
Double Head
Mowitz Butte
Lone Pine Butte
Deer Hill
Rail Mt.
Williams Reservoir
Surveyor's Valley
Lost Valley
Standard
Scheffer Mt.
Sugar Pine Ridge
Buck Butte
Crater
Round Mt.
Hole in Rock
Indian Spg.
Mayfield
Willey Ranch
White Horse Valley
Little Hot Spring Valley
Large Spring
Day
Widow Valley
Lookout
Adin
Clear Creek
Dry Pond
Badger Spg.
Corral
Duncan House Camp
Browns Well
Payne Spg.
Mud Spg.
Lava Lake
Water Hole
Crank Spg.
Stone Coal Valley
Pot Hole Valley
Steele Swamp
Steele Meadow
Mammoth Springs
Clear Lake Reservoir
Clear Lake Dam
Willow
Rock Cr.
Lost River
East Branch
North Fk.
Spring
Warner Spg.
Bird Spg.
Pot Hole Spring
Dutch Flat R.S.
Happy Camp R.S.
Pit River R.S.
Deer Hill R.S.
Hog L.
Duncan Reservoir
Spaulding Reservoir
Aquina Reservoir
Mowitz Reservoir
Dry Pond Reservoir
Basen Spg.
Grouse Spg.
Happy Camp
Modoc Lava Bed
Burnt Lava Bed
Wastewa
Scorpion
Water
Trail
Summit
Pine Cr.
Willow Cr.
Mill Cr.
Fk.
Ranch
Modoc Co.
Siskiyou Co.
Modoc Co.
F. Grahs
CALIFO
ORE
KLAMATH
Fourm
Spg
Buchen
Swamp
Canby
WA
Quo
Asp
B
M